



Airborne Particulate Threat Assessment

DE-FC26-05NT42595

Q1 Quarterly Review

Period From 1-Oct-05 to 31-Dec-05

February 8, 2006

ChemImage Corporation



Meeting Agenda



Attendees: Donald Martello, William Aljoe (DOE NETL)
Patrick Treado, Matthew Nelson, Oksana Klueva,
Jeffrey Beckstead, John Belechak, Wes Hutchison
(ChemImage)

3:00 Introductions
3:10 NETL Comments
3:40 Q1 Program Review
NETL Subcontract Status
ChemImage Task Status
4:40 Lab Tour
4:50 Wrap-up



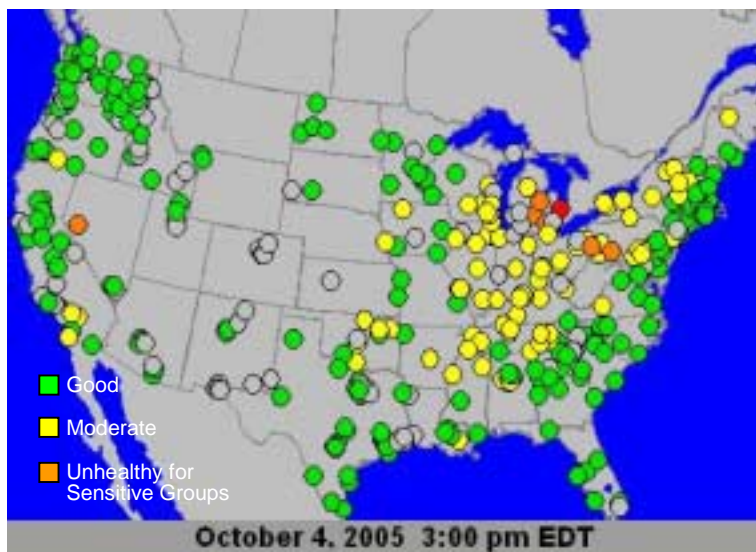


Airborne Particulate Threat Assessment (APTA)

DOE-ChemImage-QC40160R; Award DE-FC26-05NT42594

ChemImage Corporation, 7301 Penn Avenue, Pittsburgh, PA 15208

PI: Patrick Treado, Tel (412)241-7335, Fax (412)241-7311, email: treado@ chemimage.com



Airborne Particle Threat Assessment Program Overview

Objective: To advance the state of our knowledge of ambient background PM composition, with a view toward acquiring the ability to discern between the chemical/biological threat agents and ambient background PM encountered in the environment at the time of the threat agent detection.

Description: The APTA Project will accelerate the development and validation of Raman Chemical Imaging for the autonomous detection of airborne chemical and biological hazards in the environment. In collaboration with the National Energy Technology Laboratory (NETL), ChemImage will undertake a comprehensive assessment of background airborne particulate threat levels in *Western Pennsylvania*, enabling improvements in ChemImage's ongoing airborne threat detection technology.

ChemImage's FALCON II™ molecular chemical imaging systems will be used to demonstrate the high sensitivity and low false alarm potential of the technology for airborne threat detection.

Phase I

Cost: \$1.794 M

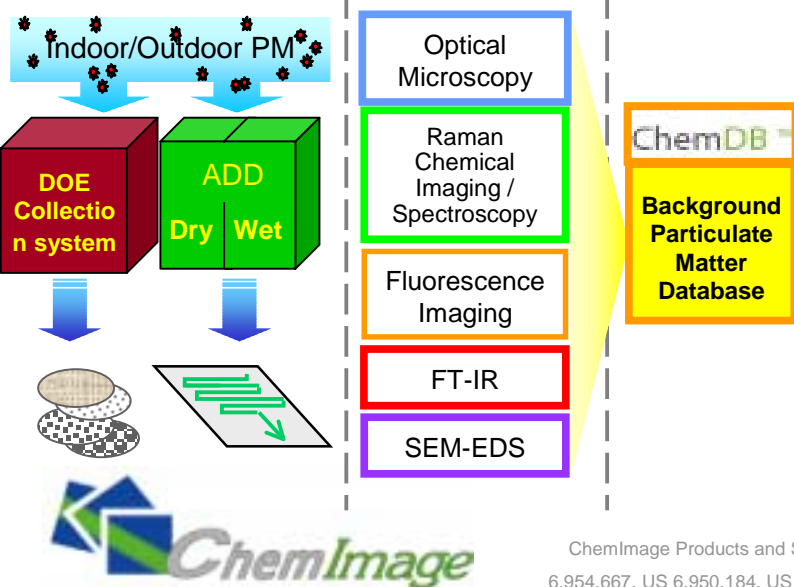
Duration: 12 months

Start: October 1, 2005

COLLECTION

DETECTION

DATABASE

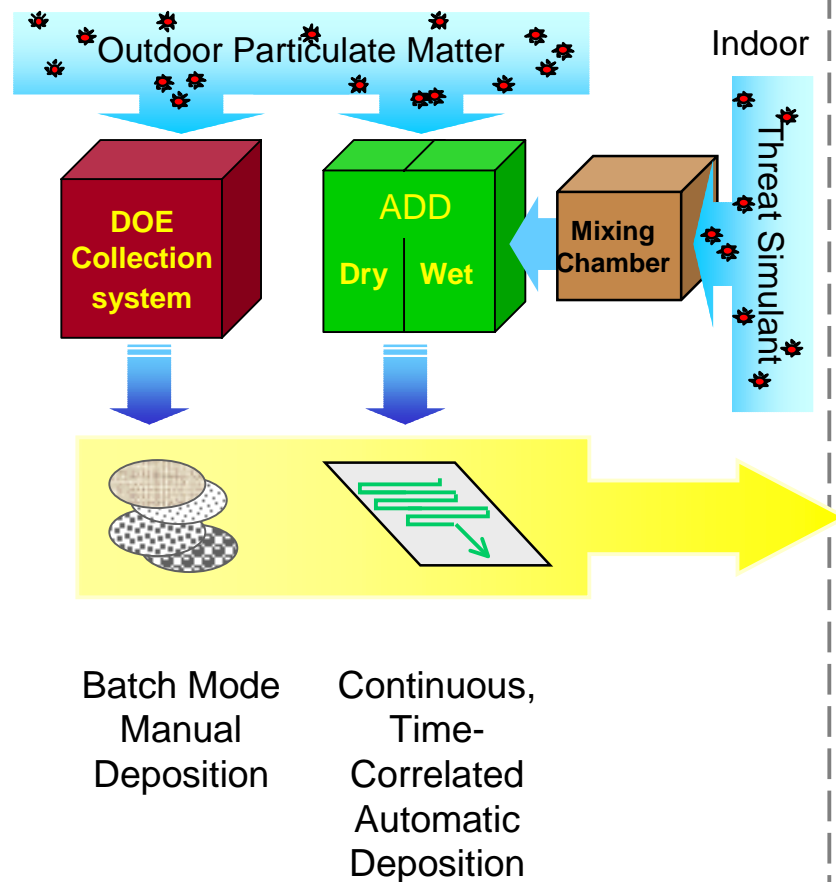


Tasks	Performer	Milestones	Deliverables
1 Assessment and Setup 1.1 Assessment of existing knowledge base 1.2 Setup and qualify ambient particulate collection equipment at CI and DOE ambient particulate collection equipment 1.2.1 ChemImage Setup 1.2.2 DOE Setup	CI/NETL CI NETL	M1 Complete Task 1	Literature review report Particle laboratory setup plan
2 Automated Deposition System Development 2.1 Investigate properties of system candidate components 2.2 Design Automated Deposition Device (ADD) 2.3 Fabricate & Test ADD	CI CI CI	M2 Qualify ADD	ADD test report
3 Collection of Ambient Background Samples 3.1 Collect full data sets on pure components - predeposition 3.2 Periodic collection of outdoor, ambient airborne particulate 3.3 Periodic Collection of indoor, ambient airborne particulate	CI/NETL CI/NETL CI/NETL	M3 Complete 1st Seasonal Particulate Collection	ADD validation testing report PM collection report
4 Detection 4.1 Analyze collected particulate matter (PM)	CI/NETL		
5 Signature Database Compilation 5.1 Compile a database of signature data sets	CI	M4 Complete remainder of Tasks 3, all of 4 and 5	PM signature analysis report PM signature database effort report
6 Final Report Task 6.1: Write final report	CI/NETL	M5 Complete Task 6	Final report on project accomplishments, including test and validation results

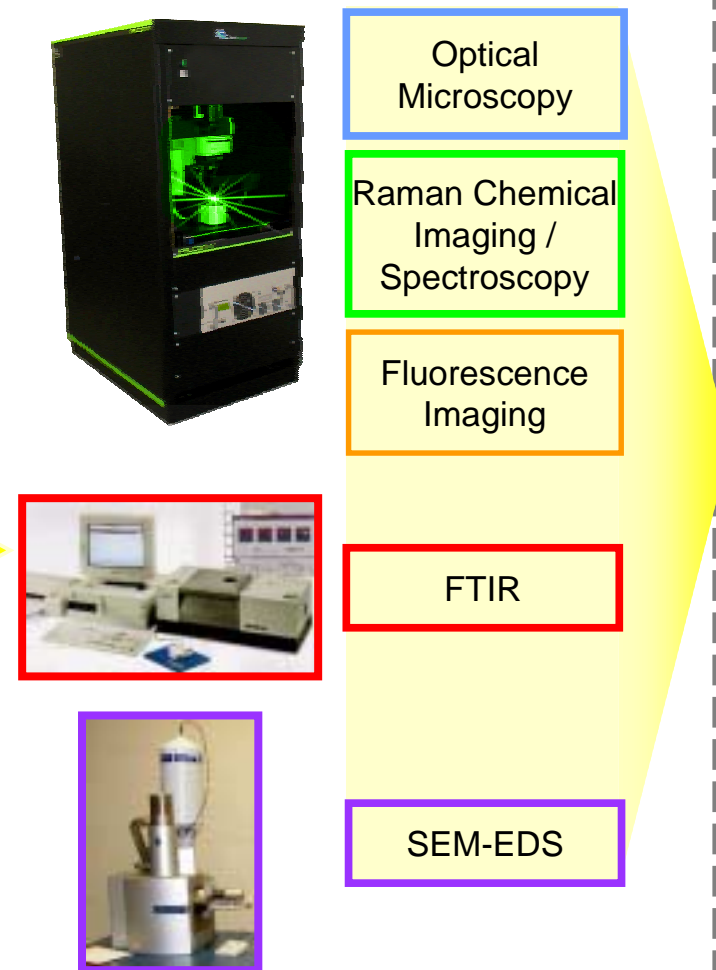
Project Workflow



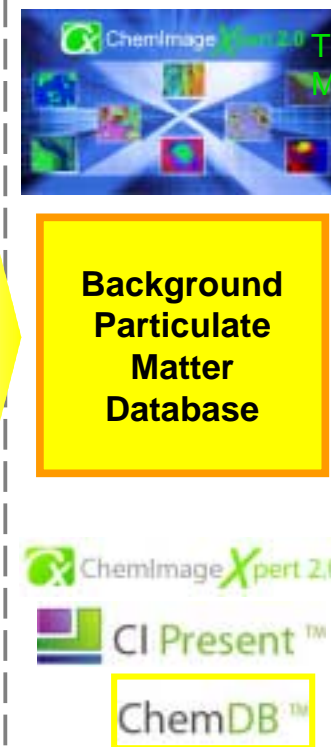
COLLECTION



DETECTION



DATABASE



APTA Schedule



#	Task Description	2005			2006								
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Assessment & Setup												
2	Automated Deposition System Development												
3	Collection of Ambient Background Samples												
4	Detection												
5	Signature Database Compilation												
6	Final Report												



Q1 Technical Progress Summary

(1-Oct-05 – 31-Dec-05)



#	Task Description	% Completed	
		Planned	Actual
1	Assessment & Setup	50%	30%
2	Automated Deposition System Development	25%	10%
3	Collection of Ambient Background Samples	20%	5%
4	Detection	20%	5%
5	Signature Database Compilation	20%	5%
6	Final Report	0%	0%

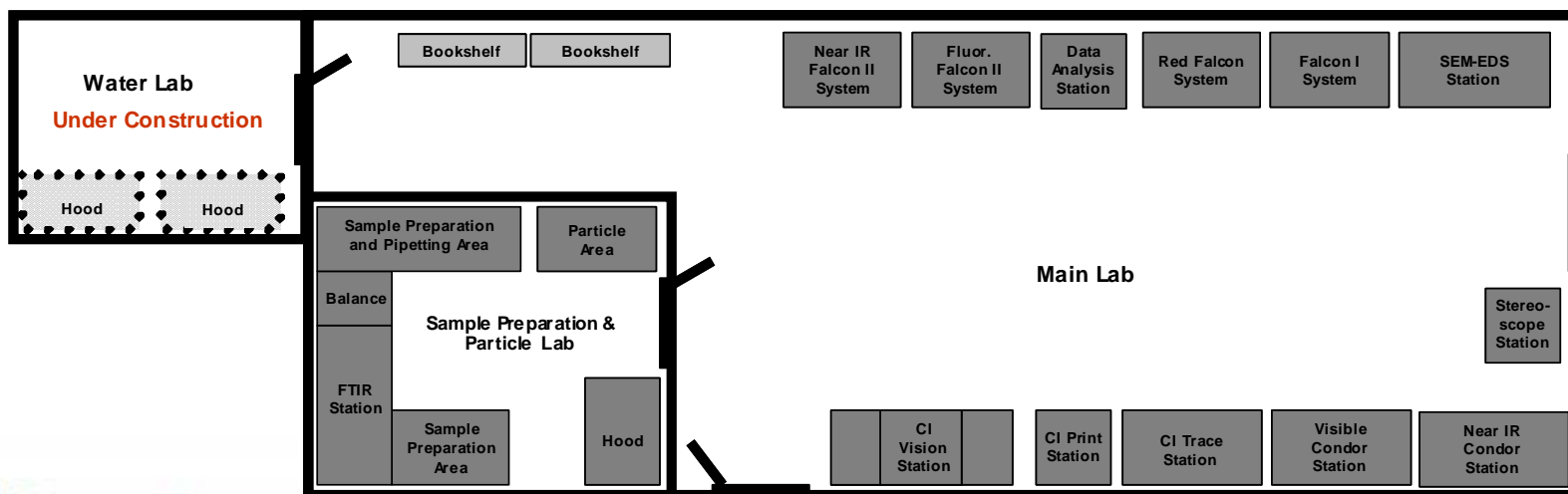


Task 1: Assessment and Setup

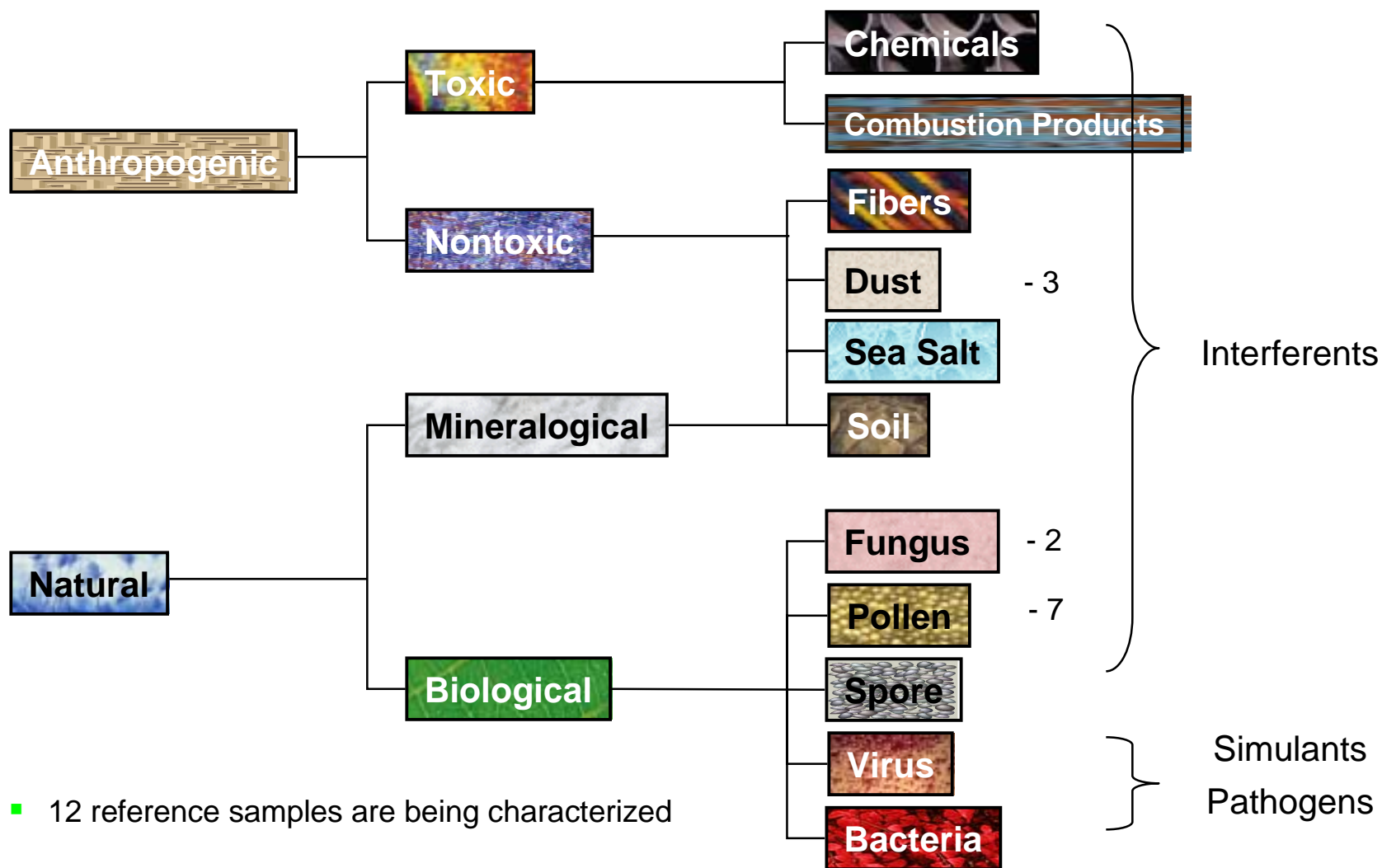


Task 1	Assessment & Setup of PM Collection Equipment	Planned	Actual
Task 1	Completion	50%	30%
1.1	Assessment of knowledge base	50%	40%
1.2	Setup and qualify PM collection equipment	50%	10%
1.2.1	ChemImage lab setup	50%	10%
1.2.2	DOE lab setup	50%	0%

- Literature review is 50% complete, additional references are being collected
- ChemImage Particle Lab Setup is in progress
 - Equipment purchases are in progress
 - In-house cross-training on established particle analysis methods is complete
 - Formal microscopy training is being arranged
- PM collection and training on DOE NETL equipment has been delayed



Task1: Taxonomy of Environmental Background





Task 2: PM Sample Deposition Development

Task 2	PM Sample Deposition Development	Planned	Actual
Task 2	Completion	25%	10%
2.1	Investigate properties of system candidate components	25%	20%
2.2	Design Automated Deposition Device (ADD)	0%	10%
2.2.1	Evaluating CI PM collection technology partners	25%	10%
2.2.2	Design Automated Particulate Integrated Collector and Detector (APICD)	0%	5%
2.3	Fabricate & Test ADD and APICD	0%	0%

- During the investigation of system candidate components, a strategic teaming relationship had been developed with a leading manufacturer of PM collectors
- ChemImage will build a prototype Automated Particulate Integrated Collector and Detector
 - Collects airborne PM from air, concentrates and deposits the enriched PM on a substrate
 - Enriched PM will be analyzed for the presence of threat materials



Tasks 3, 4, 5: Analysis of Reference Samples



#	Task Description	% Completion	
		Planned	Actual
Task 3	Collection of Ambient Background Samples	20%	5%
3.1	Collect full data sets on pure components – pre-deposition	10%	5%
3.2	Periodic collection of outdoor, ambient airborne particulate	50%	0%
3.2.1	Evaluating NETL -provided Dekati PM samples	20%	5%
3.3	Periodic Collection of indoor, ambient airborne particulate	0%	5%
Task 4	Detection	20%	5%
4.1	Analyze collected particulate matter (PM)	0%	2%
Task 5	Signature Database Compilation	20%	5%
5.1	Compile a database of signature data sets	0%	5%

Task 3: Collection of Ambient Background Samples

- Collection of new, outdoor PM has been delayed
 - Sub-contract not yet in place with NETL
 - Previously supplied NETL outdoor PM collected via Dekati sampler scheduled for evaluation
- APTA testing protocol has been defined
- A Biological Simulant was identified as a suitable industry standard for collector validation
 - Simulant was tested on all laboratory equipment applicable to APTA
- Indoor ambient particulate matter procured for characterization
 - NIST Urban Dust
 - Greer Labs House Dust: HSARPA RABIS 1A Lot; HSARPA RABIS 1B Lot
 - Congressional mail screening facility dry filter unit (DFU) Mail Dust
- In-house reference samples are being evaluated (10 biological pollen samples)





Task 4: Detection

- Optical Microscopy techniques
 - Brightfield Reflectance (BFR)
 - Polarized Light Microscopy (PLI)
 - Differential Interference Contrast (DIC)
 - Autofluorescence Optical Image (FLI)
 - Macro Digital Recording (MDR)
- Spectroscopy techniques
 - Raman Dispersive Spectroscopy (RS)
 - Fourier Transform IR spectroscopy (FTIR)
- Chemical Imaging techniques
 - Raman Chemical Imaging (RCI)
 - NIR Diffuse Reflectance Imaging (NCI)
 - Fluorescence Chemical Imaging (FCI)
- Scanning Electron Microscopy
 - with Energy Dispersive X-Ray Spectroscopy (SEM-EDS)

#	MO	MDR	BFRM	BFR	FLIM	PLI	DIC	RS	FAST	RCI	FCI	FTIR	NCI	SEM-EDS
1	6.3	+	×	×	×	×	×	×	×	×	×	×	×	×
2	10x	×	+	×	+	×	×	×	×	×	×	×	+	×
3	100x	×	×	+	×	+	+	+	+	+	+	×	+	×
4	-	×	×	×	×	×	×	×	×	×	×	+	×	×
5	-	×	×	×	×	×	×	×	×	×	×	×	×	+

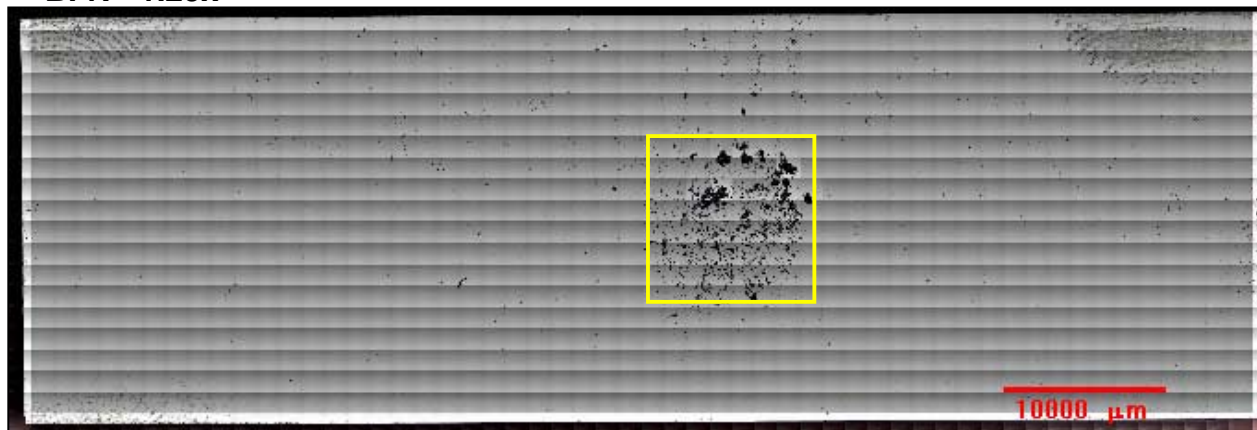


House Dust - s3543:

Deposition Spot



BFR - 1.25x



FLI- 1.25x

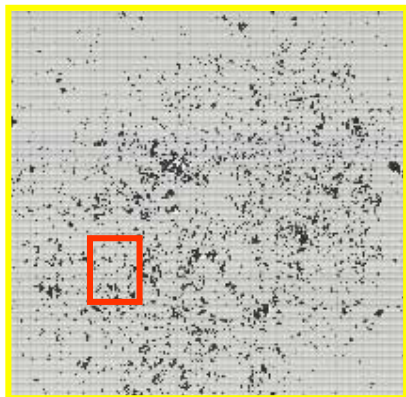


House Dust - s3543:

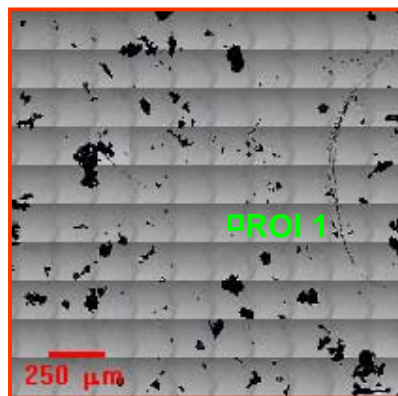
Optical Montages of the Deposition Spot



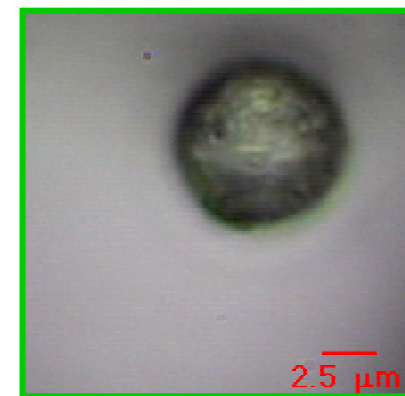
BFR Montage (59x59 FOVs) at 10x



BFR Montage 10x10 at 10x



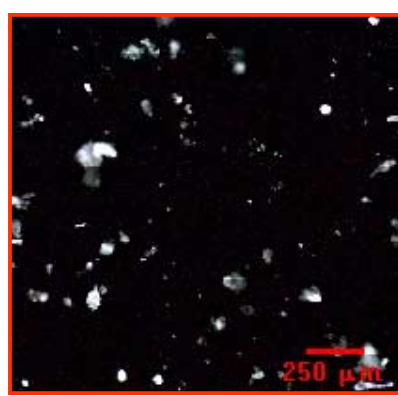
BFR ROI 1 at 100x



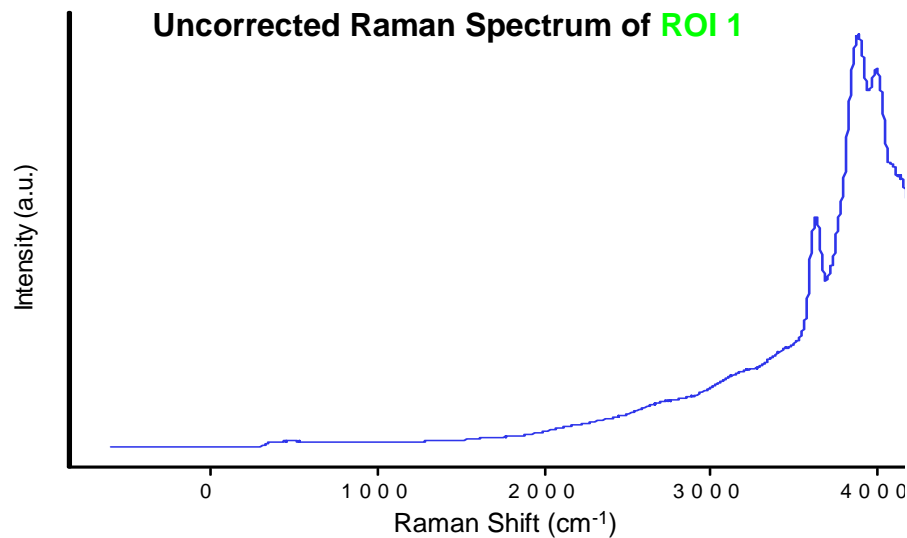
FLI Montage at 10x



FLI Montage 10x10 at 10x

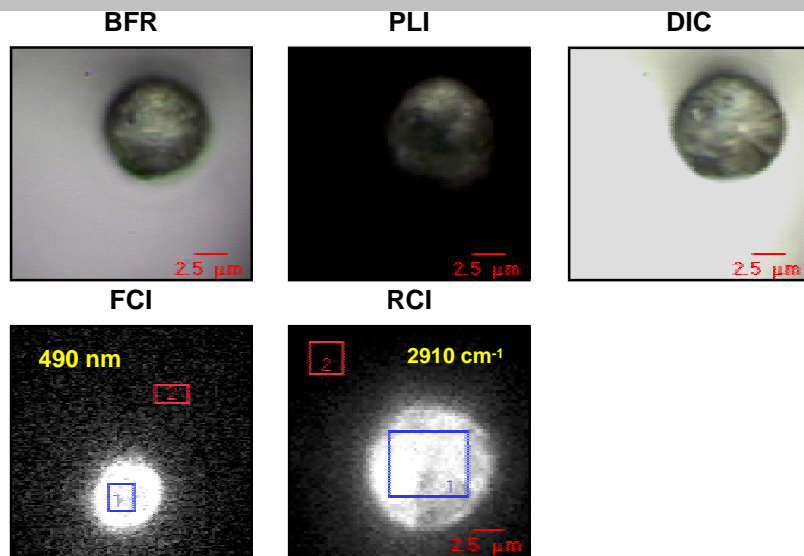


Uncorrected Raman Spectrum of ROI 1



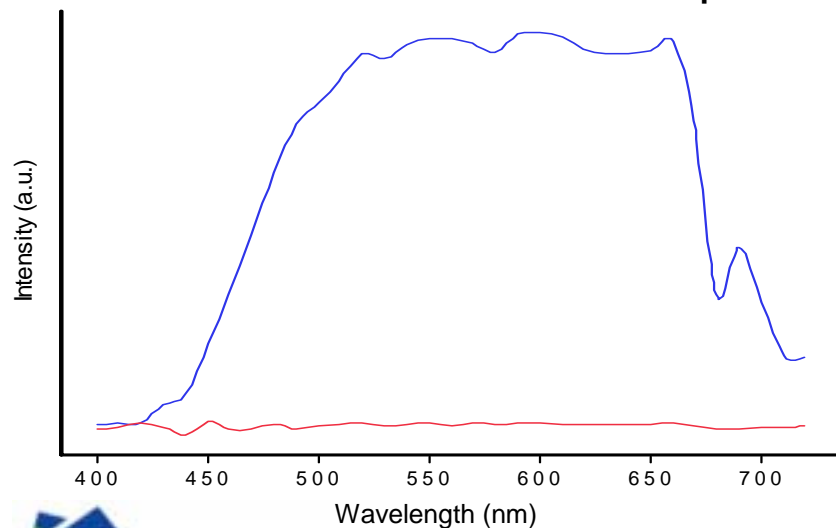
House Dust - s3543:

ROI1 Chemical Images on Falcon II at 100x

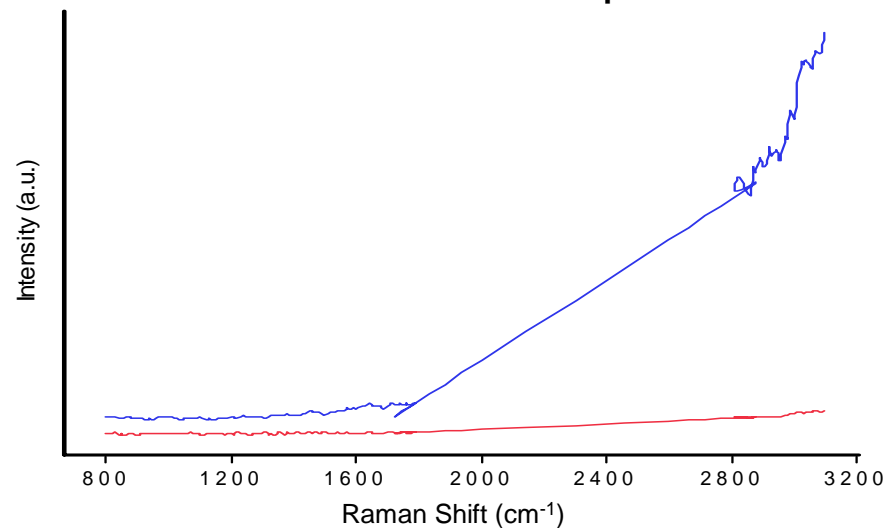


	RCI	FCI
Laser Wavelength (nm) / Objective / NA	532 / 100x / 0.95	- / 100x / 0.95
Laser Spot Diameter (μm)	24	-
Laser Power (mW)/Power Density (W/cm²)	30 / 6.4x 10 ²	-
Spectral Resolution	10 cm ⁻¹	10 nm
Time to Photobleach (secs)	300	-
Integration Time (secs) / # Avgs	15 x1	2 x1
Scanned Region	800-1800 cm ⁻¹ , 2800-3200 cm ⁻¹	400-720 nm
Binning	4x4	4x4

LCTF-Generated Fluorescence Spectra

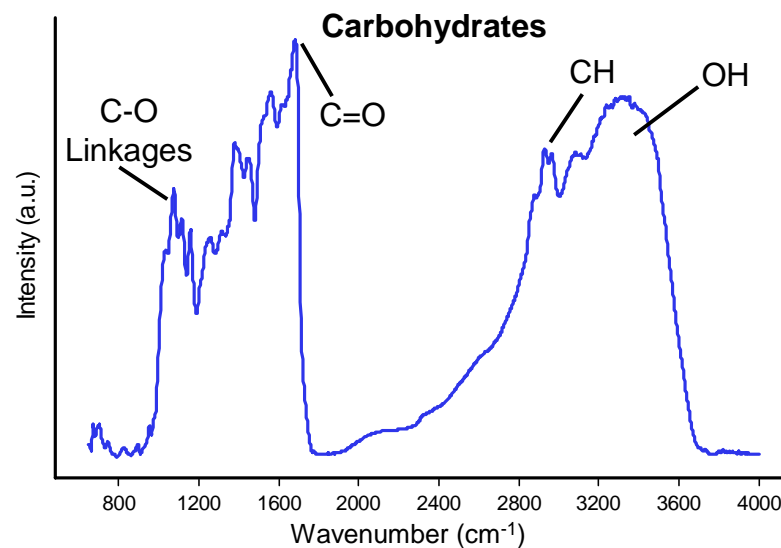
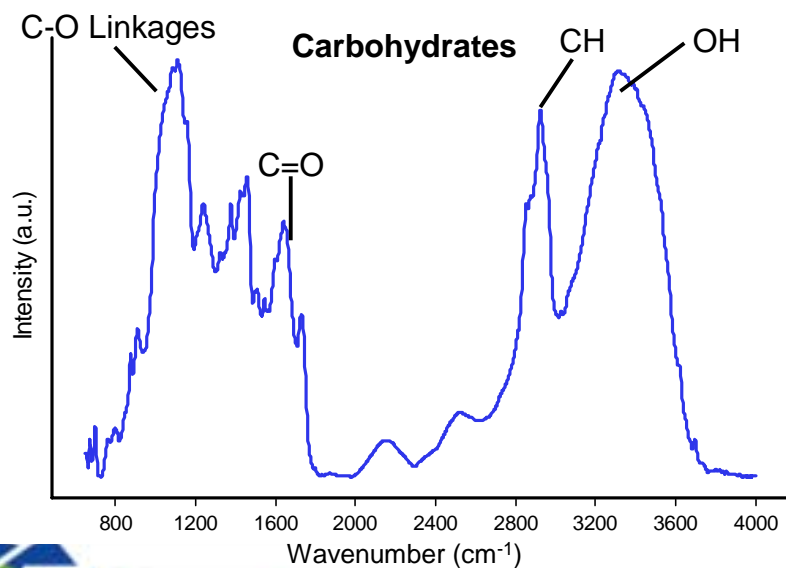
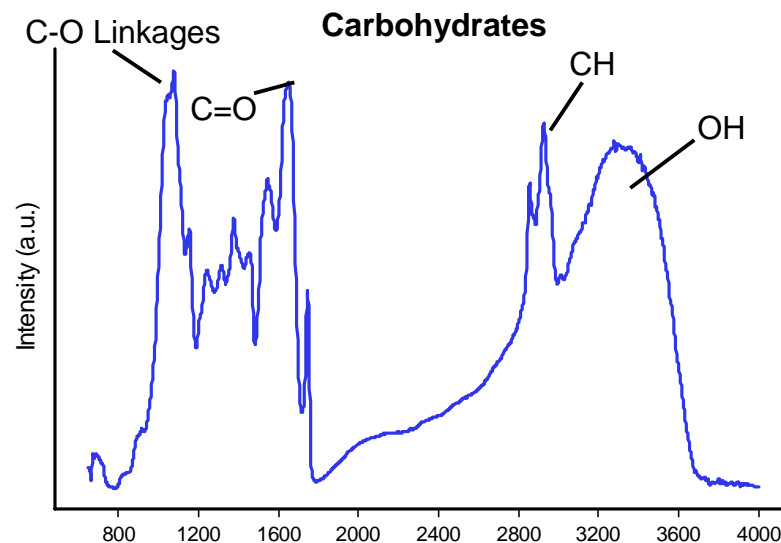
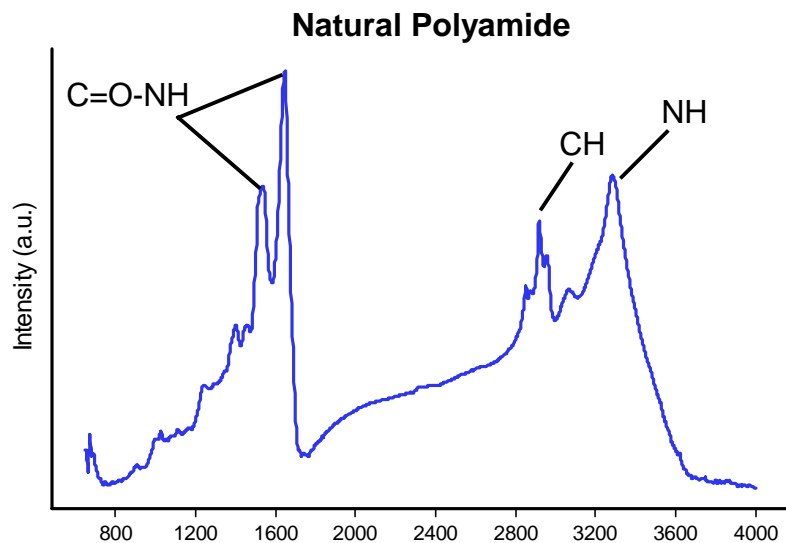


LCTF-Generated Raman Spectra



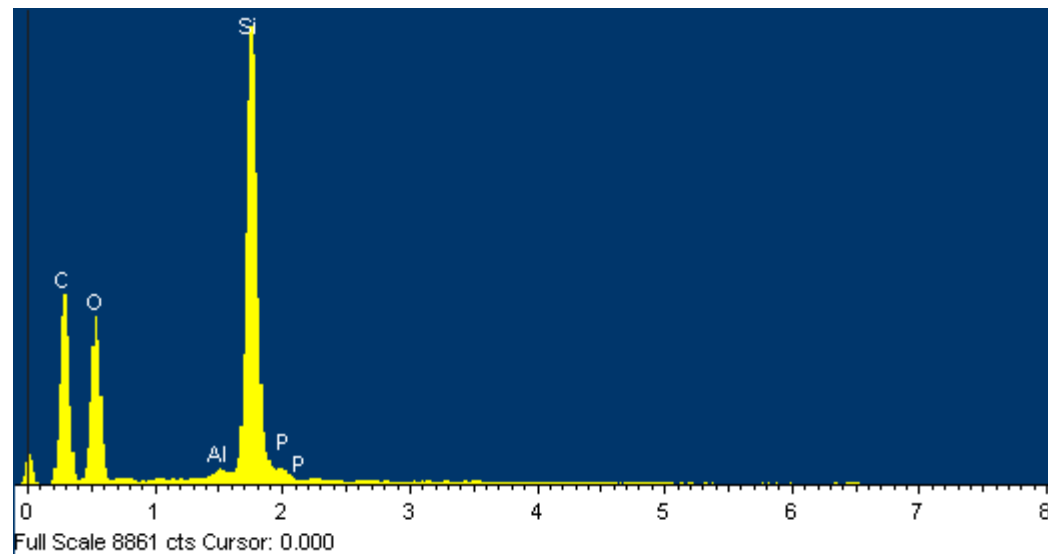
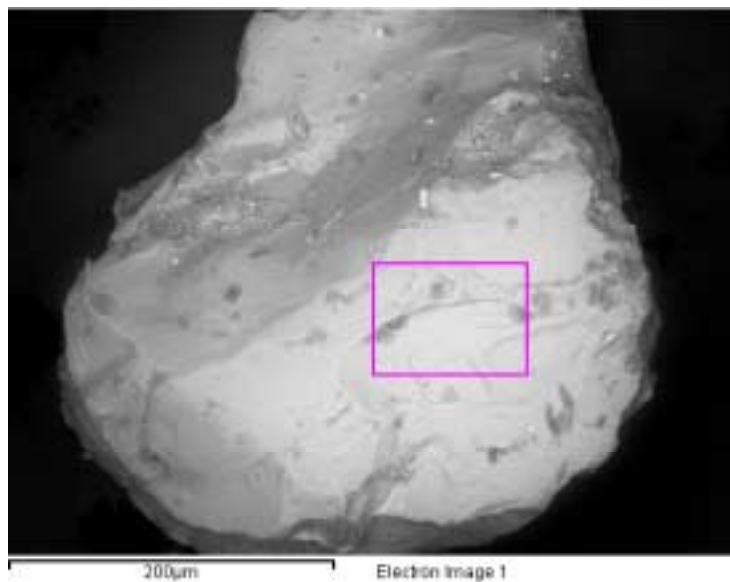
House Dust - s3543:

FTIR Spectra of s3543 sub-samples



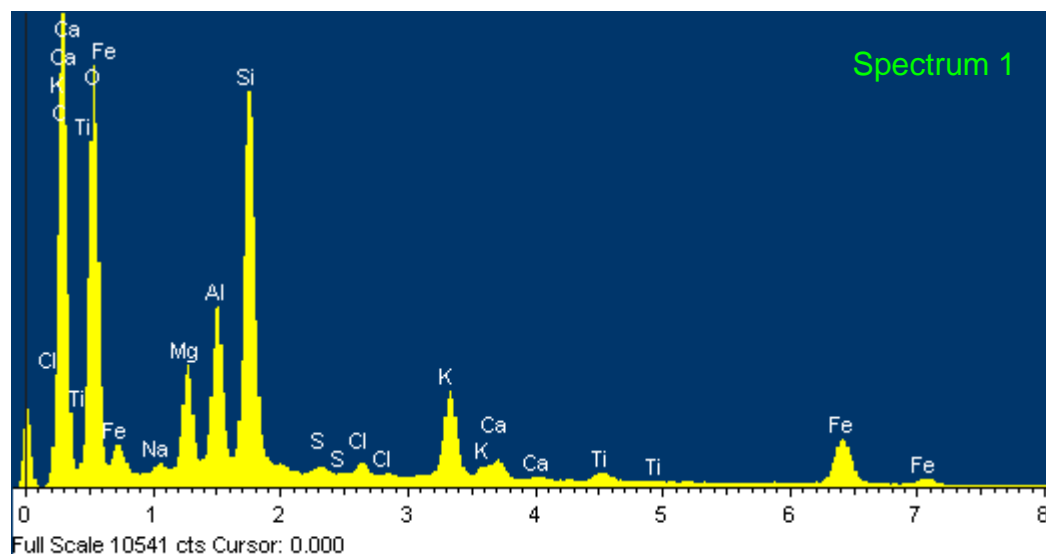
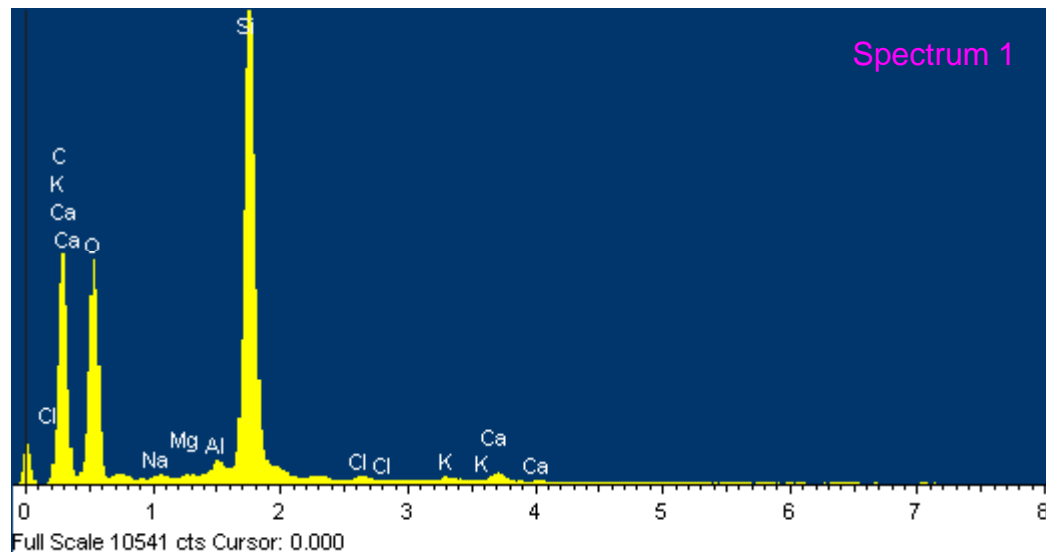
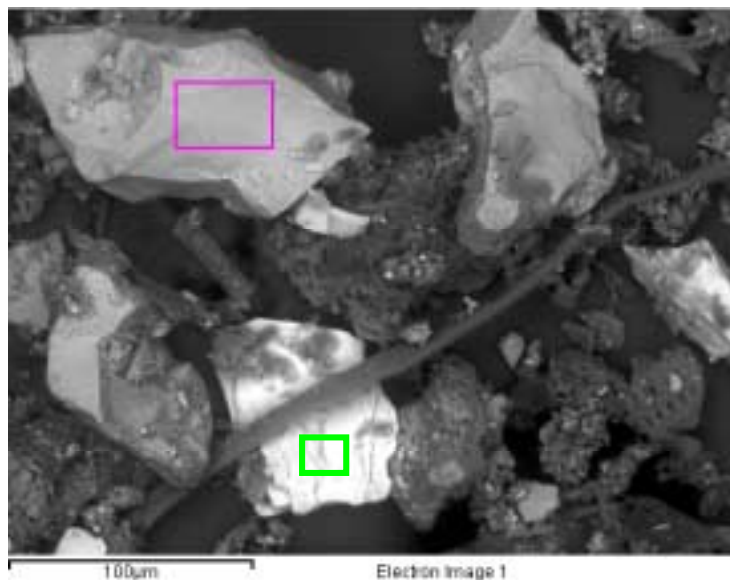
House Dust - s3543:

SEM-EDS Data of Sub-sample 1



House Dust - s3543:

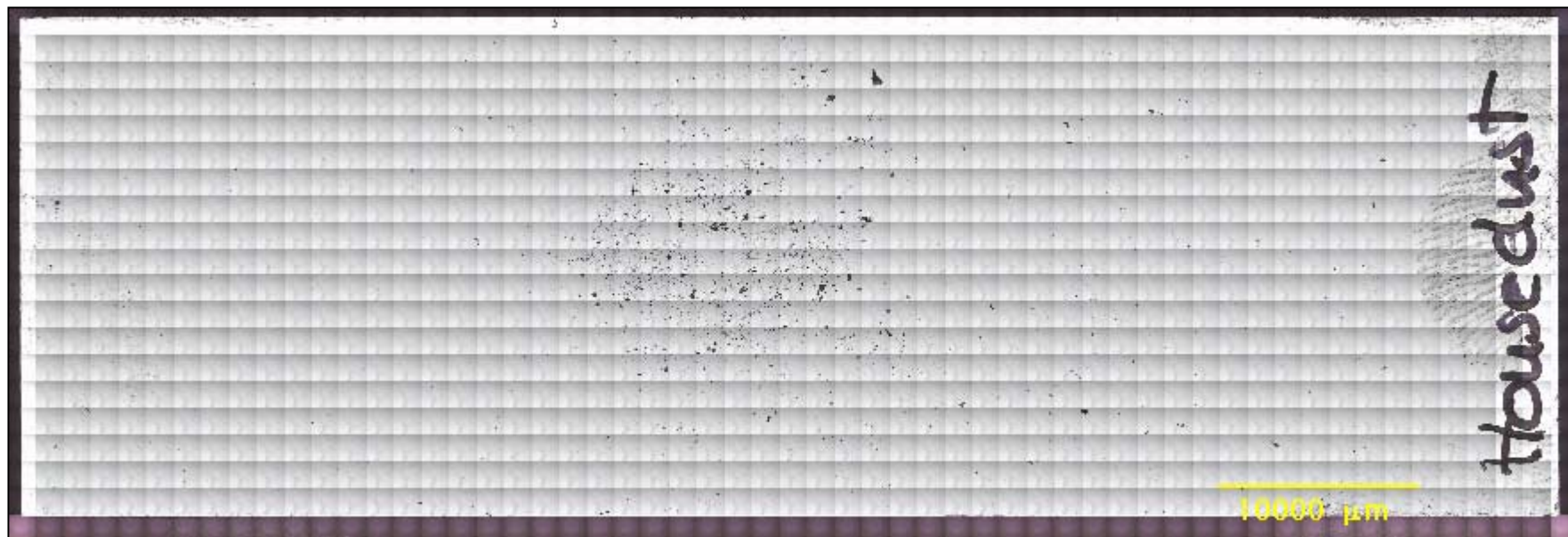
SEM-EDS Data of Sub-sample 2



Greer House Dust - s2984



Optical Montage of Deposition Spot at 1.25x

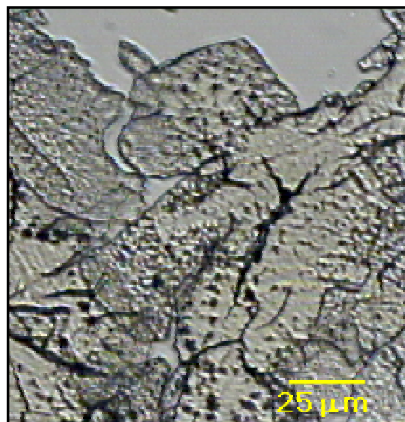


House Dust - s2984:

Dispersive Raman Spectrum of Sub-sample A



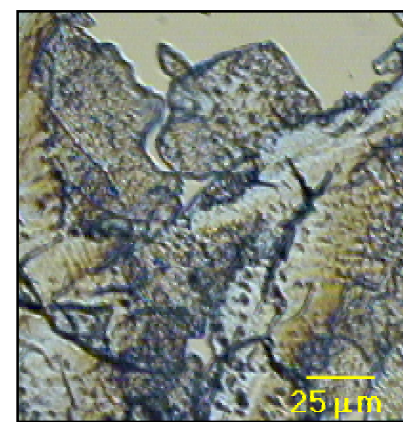
BFR



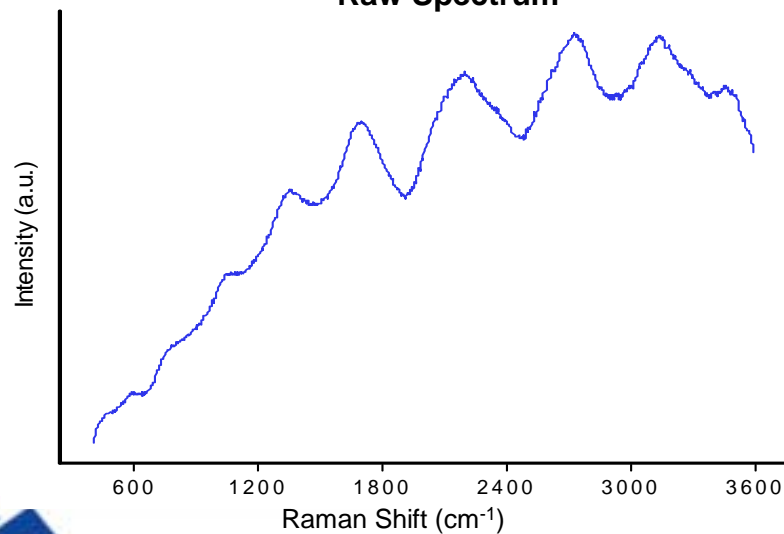
PLI



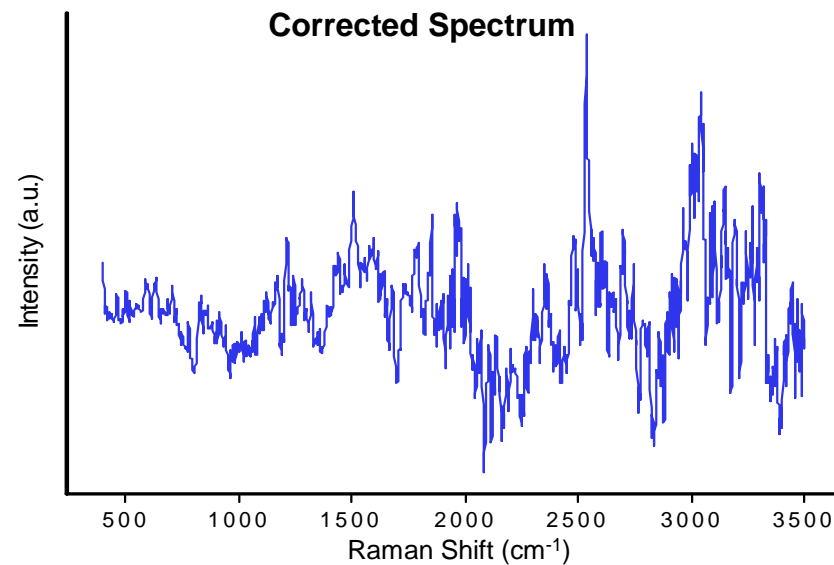
DIC



Raw Spectrum

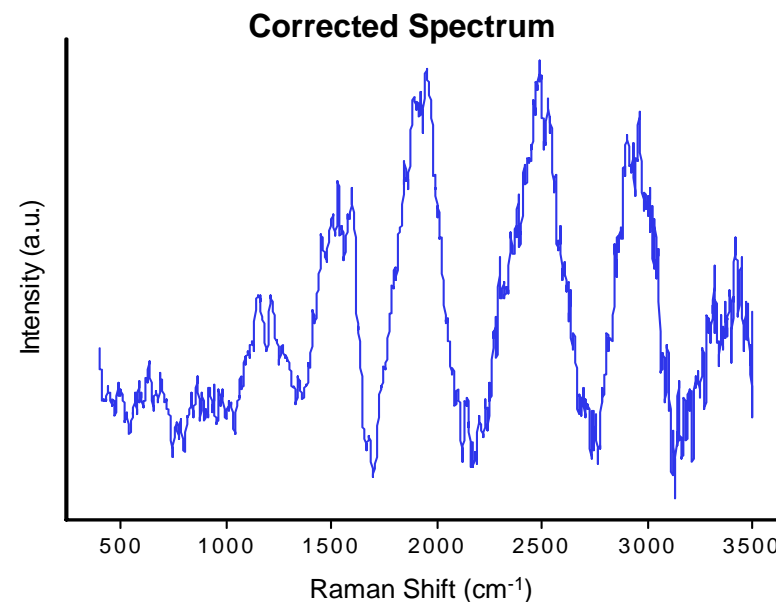
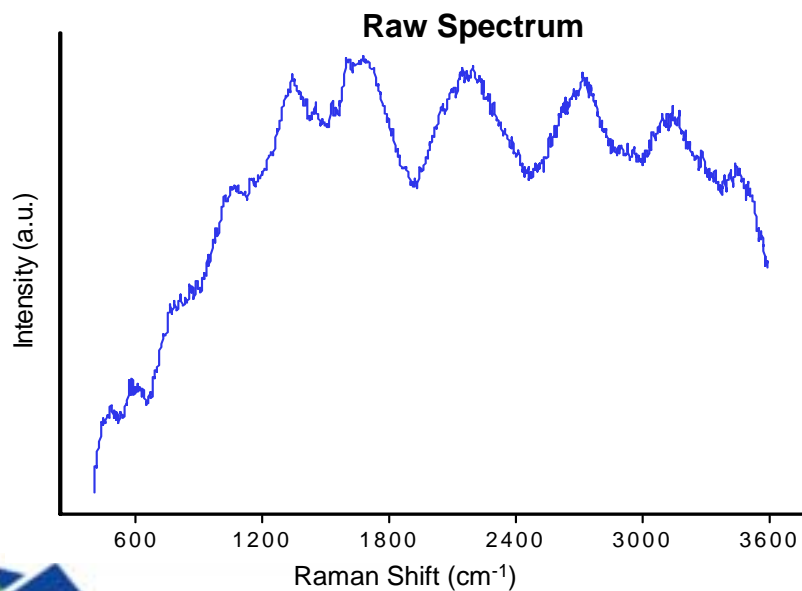
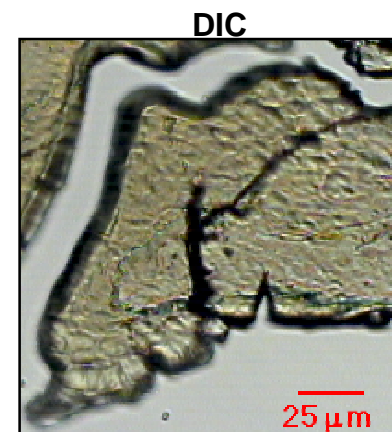
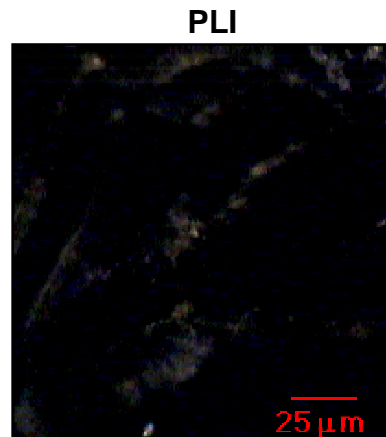
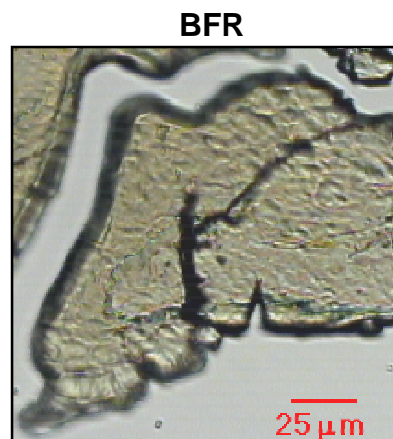


Corrected Spectrum



House Dust - s2984:

Dispersive Raman Spectrum of Sub-sample B

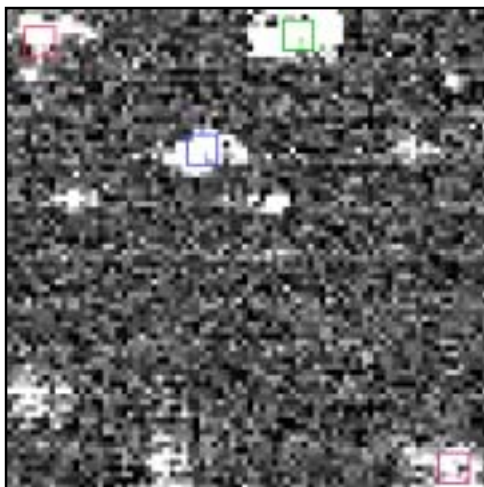
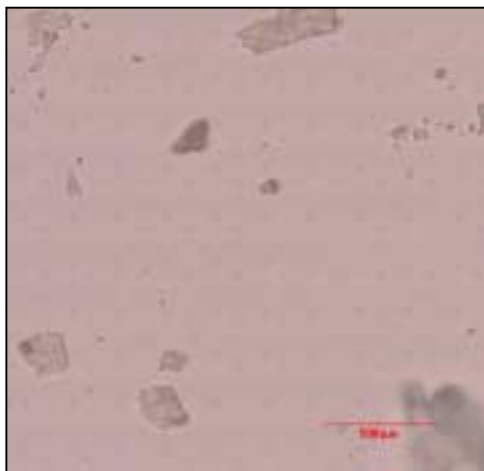


House Dust - s2984:

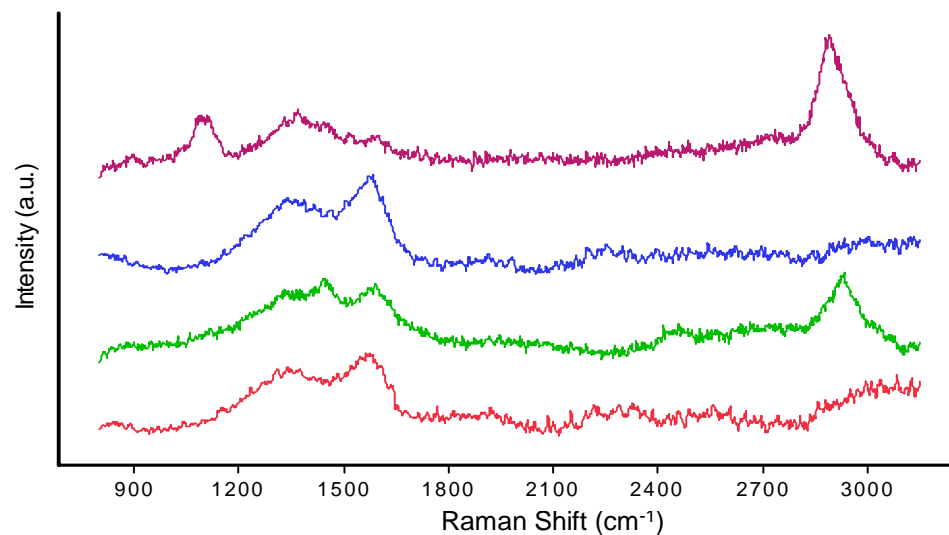
FAST Spectral Image of s2984 at 100x



10x10 BFR Montage

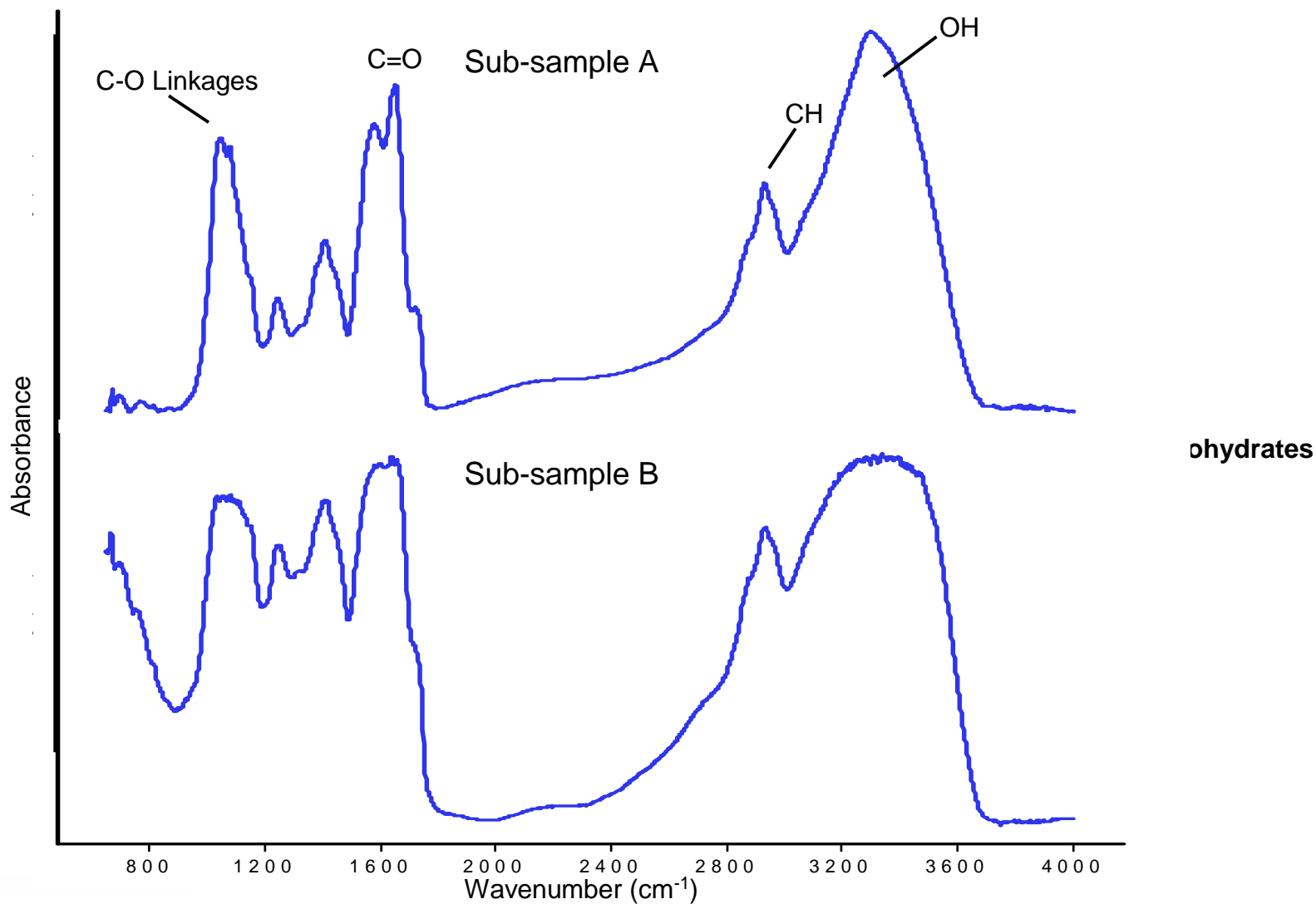


	RCI
Laser Wavelength (nm) / Objective / NA	532 / 100x / 0.95
Agent	BioSim
Laser Spot Diameter (μm)	24
Laser Power (mW)/Power Density (W/cm^2)	100 / 2.1×10^3
Spectral Resolution	14
Time to Photobleach (secs)	300
Integration Time (secs) / # Avgs	8 x 1
Binning	1x1
Signal / Background	17



House Dust - s2984:

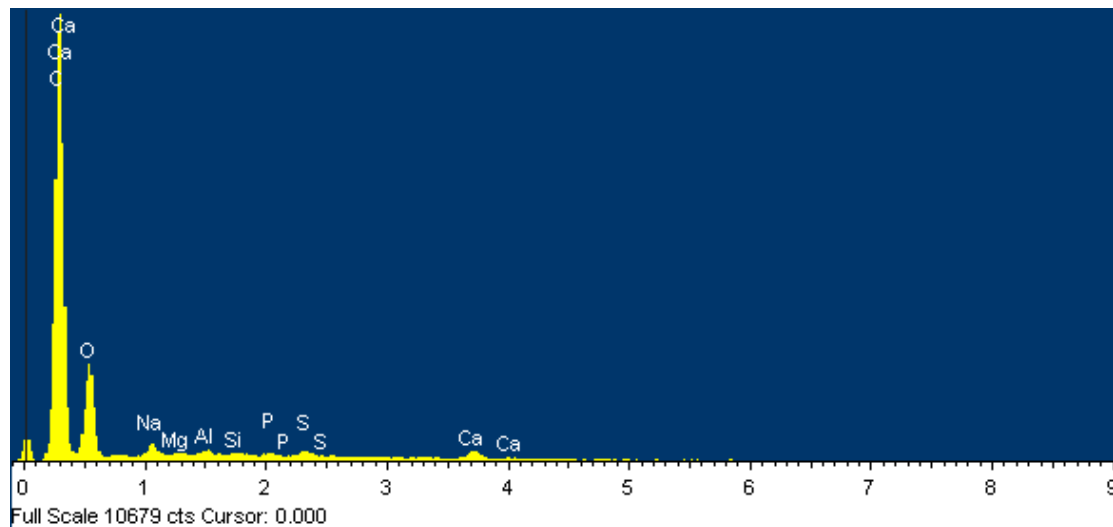
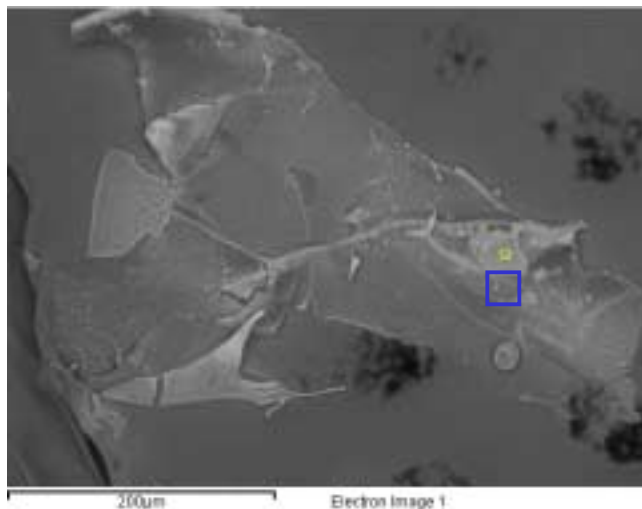
FTIR Spectra of Greer House Dust



House Dust - s2984:

SEM-EDS Data of Sub-sample A

Primary Component

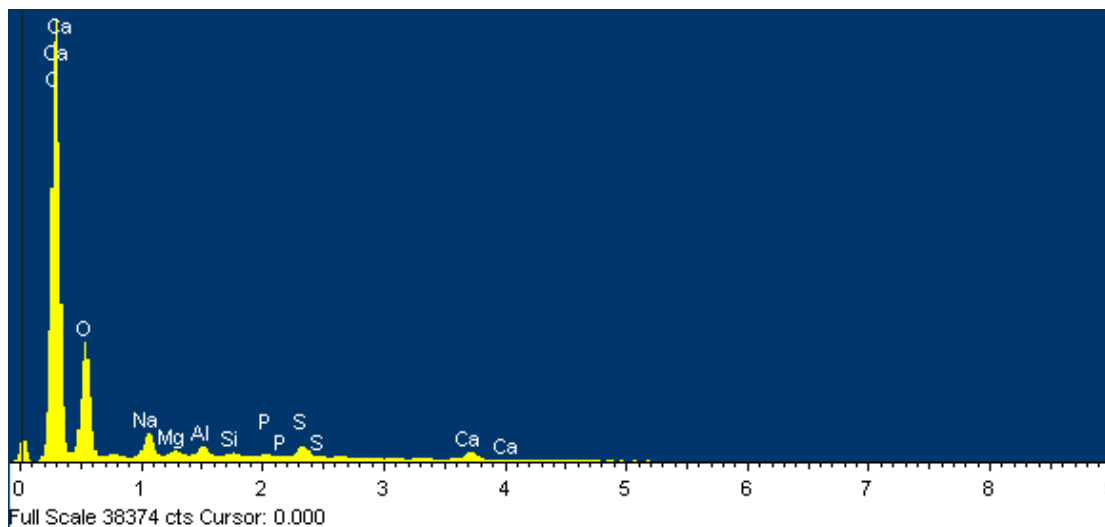


House Dust - s2984:

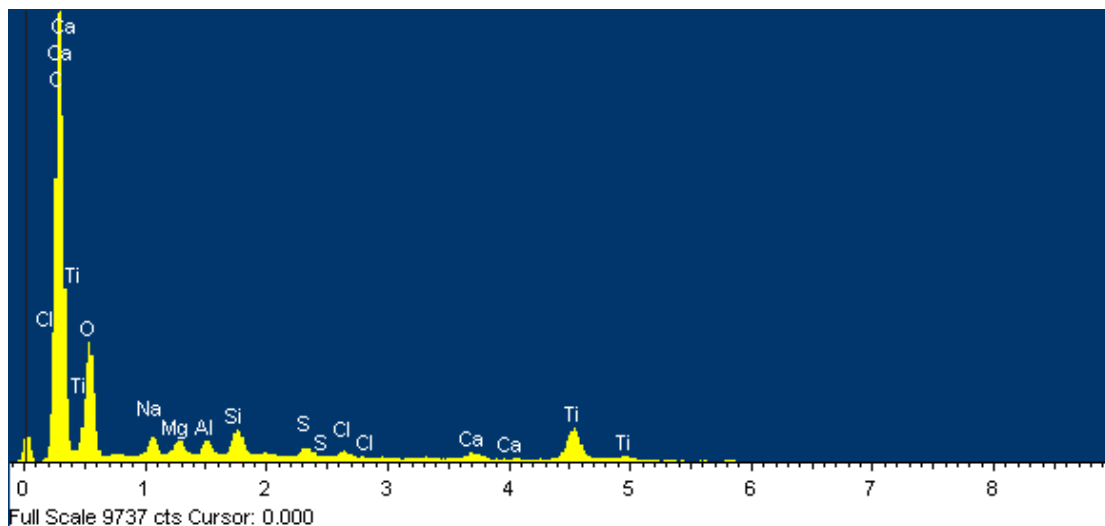
SEM-EDS Data of Sub-sample B



Primary Component



Secondary Component



Planned Activities within Q2

(January- April, 2006)



- Task 1:
 - Complete literature review
 - Place NETL subcontract
 - Complete formal particle training
- Task 2:
 - Purchase ultrasonic particulate delivery system from Sono-Tek
 - Setup Sceptor electrostatic wet collector – due February 2006
 - Complete ADD preliminary design
 - Complete APICD requirements definition and concept design
- Task 3: Begin training on NETL Dekati sampler
- Task 4: Continue background PM evaluations
- Task 5: Continue to compile database

